Developing organisational capabilities through customer-led systems integration projects: the case of the major project BT 21st Century Network in the UK

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DEVELOPING ORGANISATIONAL CAPABILITIES THROUGH CUSTOMER-LED SYSTEMS INTEGRATION PROJECTS: THE CASE OF THE MAJOR PROJECT BT 21ST CENTURY NETWORK IN THE UK

ABSTRACT

Traditional approaches to systems integration in major projects take the strategy of selecting a supplier-led prime/systems integrator. Although this strategy pushes a significant amount of risk to the supplier, project performance may suffer due to lower engagement of the customer in the anticipation of potential issues involving a major project. Thus, this research investigates the implications of the customer, as opposed to a selected external supplier, assuming the role of systems/prime integrator. A case study approach is conducted on the major project BT 21st Century Network (BT21CN) to demonstrate that customer-led systems integration projects may provide more balance in the relationship and distribution of risks between supplier and customer, having a positive impact on project performance and on accelerating the development of BT's organisational capabilities.

Keywords: Customer-Led Systems Integration Projects; Major Projects; Organisational Capabilities; Project Performance; BT 21st Century Network (BT21CN).

DESENVOLVENDO CAPACIDADES ORGANIZACIONAIS ATRAVÉS DE PROJETOS DE INTEGRAÇÃO DE SISTEMAS LIDERADOS PELO CLIENTE: O ESTUDO DE CASO DO PROJETO DE LARGA ESCALA BT 21ST CENTURY NETWORK NO REINO UNIDO

RESUMO

Abordagens tradicionais para integração de sistemas em projetos de larga escala assumem a estratégia de selecionar um integrador de sistemas liderado por uma empresa fornecedora. Embora esta estratégia transfira uma quantidade significativa de risco para o fornecedor, o desempenho do projeto pode ser prejudicado devido ao baixo engajamento do cliente na antecipação de problemas potenciais envolvendo o projeto de larga escala. Desta forma, esta pesquisa investiga as implicações de quando o cliente, ao invés de o fornecedor externo selecionado, assume o papel de integrador principal de sistemas. Uma abordagem de estudo de caso é conduzida considerando o projeto de larga escala BT 21st Century Network (BT21CN) para demonstrar que projetos de integração de sistemas liderados pelo cliente podem proporcionar maior equilíbrio no relacionamento e distribuição de riscos entre o fornecedor e o cliente, resultando em um impacto positivo no desempenho do projeto e na aceleração do desenvolvimento das capacidades organizacionais da empresa BT.

Palavras-chave: Projetos de Integração de Sistemas Liderados pelo Cliente; Projetos de Larga Escala; Capacidades Organizacionais; Desempenho de Projetos; BT 21st Century Network (BT21CN).

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1 INTRODUCTION

This paper discusses the role of customer-led systems integration projects on the development of organisational capabilities when such a customer firm is undertaking a major project for infrastructure change and business transformation. For major infrastructure projects, the turn key model is frequently used (see, for example, Flyvbjerg et al. (2003)) and, within this model, a prime integrator from the supplier side is common. The same approach is used for developing many of the high technology complex products and systems, such as complex weapons for the military sector (see, for example, Prencipe et al. (2003), and Davies and Hobday (2005)). Hobday, Davies and Prencipe (2005) argue that for complex capital projects, systems integration has become a core strategic capability of the corporation. However, the role of projects delivering systems integration is usually approached from the supplier side (Davies, 2003; Kapletia & Probert, 2010; Prencipe, 2003). Exceptions are Brady and Davies (2010) and Davies et al. (2009) who examine the case of the construction of London Heathrow Terminal 5, a customer-led systems integration major project, deemed as a case of project success. This has implications on the risk management or risk-bearing capacity for the governance of projects, especially major projects (see, for example, Chang (2015)).

When it comes to high-technology infrastructure building, for example, building a telecommunications network, the dynamics of procurement can be challenging. In terms of selecting suppliers and the level of relationship with them, from the customer perspective, there are two main issues involved. The first is to select suppliers that can deliver value not only in terms of building the infrastructure (i.e. the project itself), but also in terms of its evolution (i.e. its operation and 'technological' evolution). The second is to decide the role of systems integrator and to whom assign this responsibility: to the supplier side or to the customer side.

This paper focuses on the decision of the customer to be the systems integrator, not delegating this role to a supplier. The proposition is that a more active role played by the customer as prime integrator, i.e. customer-led systems integration project, may lead to better project performance under certain conditions. However, this comes with a cost associated to it, in terms of learning and building project capabilities, and with the customer potentially capitalising on such capabilities in future business projects. Thus the main questions of this paper are:

- *What is the impact of customer-led systems integration on the organisational capabilities of the customer?*
- *To what extent is it worthwhile for the customer to assume the role as prime integrator (instead of having the prime integrator role in the supplier side)?*

In order to investigate these questions, a major project was selected: BT 21st Century Network (BT21CN). This is a £10 billion, 5-year project, undertaken to renew BT's traditional network to one using massively the Internet Protocol (IP) at its core.[2] This is a unique opportunity to investigate these questions as other incumbent telecom operators (such as Deutsche Telekom and Orange) have not taken this same approach of undertaking a major project. This major project has BT as its customer. BT undertook a careful selection of major vendors/suppliers, and BT decided to assume the systems integration role, not delegating it to a prime contractor from the supplier side. In terms of procurement, it shows the nature of long-term partnership that needs to be developed with suppliers, and the hurdles of the customer assuming the role of systems integrator. Managerial implications for firms as customers willing to undertake the role of systems integrator are discussed.

This paper is part of a broader research that investigated the use of projects and programmes for business transformation of incumbent telecommunications operators. The research was based on case study method and it was done in three stages. The evidence was obtained through documentary analysis and a large number of interviews. The research methodology is further explained in Section 3.

This paper is structured as follows. Section 2 positions the literature on systems integration and organisational capabilities for the management of complex/major projects, highlighting the issue of positioning the systems integrator role (at the supplier or customer side). Section 3 describes the case study research methodology. Section 4 presents the case study on BT21CN, using the framework of systems integration (as a dynamic capability) and organisational capabilities (as shown in Figure 3). Section 5 discusses the overall impact that the customer-led systems integration project (BT21CN) has on the long-term development of organisational

[2] BT issued a press release on 09th June 2004 announcing its plan to build BT21CN.

capabilities of BT. Section 6 concludes the paper and highlights some managerial implications for the customer-led systems integration project.

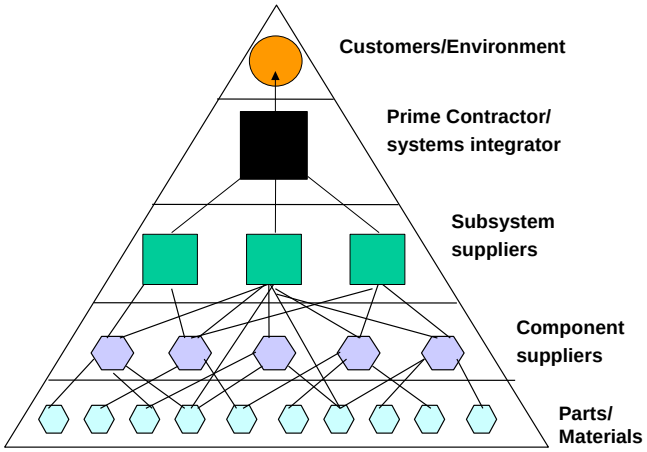
2 SYSTEMS INTEGRATION PROJECTS AND ORGANISATIONAL CAPABILITIES

This brief literature positions systems integration projects and organisational capabilities, pointing out the issue of positioning the systems integrator role. It highlights some of their characteristics and shortcomings when dealing with the management of complex projects, elaborating the framework of analysis that is used for the case study of BT21CN.

2.1 Systems Integration Projects

The concept of systems integration has long been explored as a capability related to the identification of organisational boundaries (Brusoni, Prencipe, & Pavitt, 2001; Prencipe, 1997). In the context of capital goods projects, systems integration has become a core capability of the organisation (Davies, 2004; Hobday et al., 2005), and that it can be interpreted as an instance of dynamic capabilities in the way systems integration deals with changes in a 'turbulent' environment (e.g. Chagas Jr., Leite, & Jesus, 2017; Eisenhardt & Martin, 2000; Teece & Leih, 2016; Teece, Peteraf, & Leih, 2016; Teece & Pisano, 1994, 1998; Teece, Pisano, & Shuen, 1997; Winter, 2003). Prencipe (2003) uses the aircraft engine industry in order to demonstrate how systems integration capabilities are important for firms to coordinate networks of suppliers and to compete successfully when delivering complex products and systems. Systems integration has been pointed out as a major challenge in the management of major (system of system or array type) projects (Davies & Mackenzie, 2014). Systems integration is usually seen as a core strategic capability of the supplier, assuming the role of prime integrator in more complex projects as shown in Figure 1.

Figure 1 – The Integration of Systems



Source: Davies and Hobday (2005, p. 43)

Systems integration is subordinated to systems thinking whose implementation brings wider implication on risk management, more specifically how risk is going to be shared by the different actors/stakeholders. This is particularly important for major projects, such as public private partnership projects (see, for example, Loosemore and Cheung (2015)) and other 'private' projects such as Heathrow Terminal 5 (Davies et al., 2009). Systems Engineering, another branch of systems thinking, is also proposed to address the governance of complex project environments (Locatelli, Mancini, & Romano, 2014). Kapletia and Probert (2010) state that there is a predominance in the literature to consider systems integration in complex systems environments adopting the supplier perspective. However, in more recent major projects such as the construction of London Heathrow Terminal 5, the customer BAA (British Airports Authority)[3] has assumed the role of systems integrator, assuming the risks inherent to it (Brady & Davies, 2010; Caldwell, Roehrich, & Davies, 2009; Davies et al., 2009; Gil, Miozzo, & Massini, 2012). In particular, Brady and Davies (2010) highlight that

[3] BAA, now Heathrow Airport Holdings, is the owner of London Heathrow Airport.

BAA went through a process of project capability building and this had further impact on their overall organisational capabilities to conduct further projects. The customer-led systems integration as occurred in the major project for the construction of London Heathrow Terminal 5 may lead to a higher probability of major project success due to the deeper involvement of the customer (BAA) and stricter checks and balances. These initial governance decisions may avoid major issues such as the hold-up problem as it happened in the major project of the Channel Tunnel (see, for example, Chang and Ive (2007) and Genus (1997)). Moreover, this is accompanied by the development of project capabilities that may have a significant impact on organisational capabilities, which is briefly reviewed in the following sub-section.

2.2 Organisational Capabilities

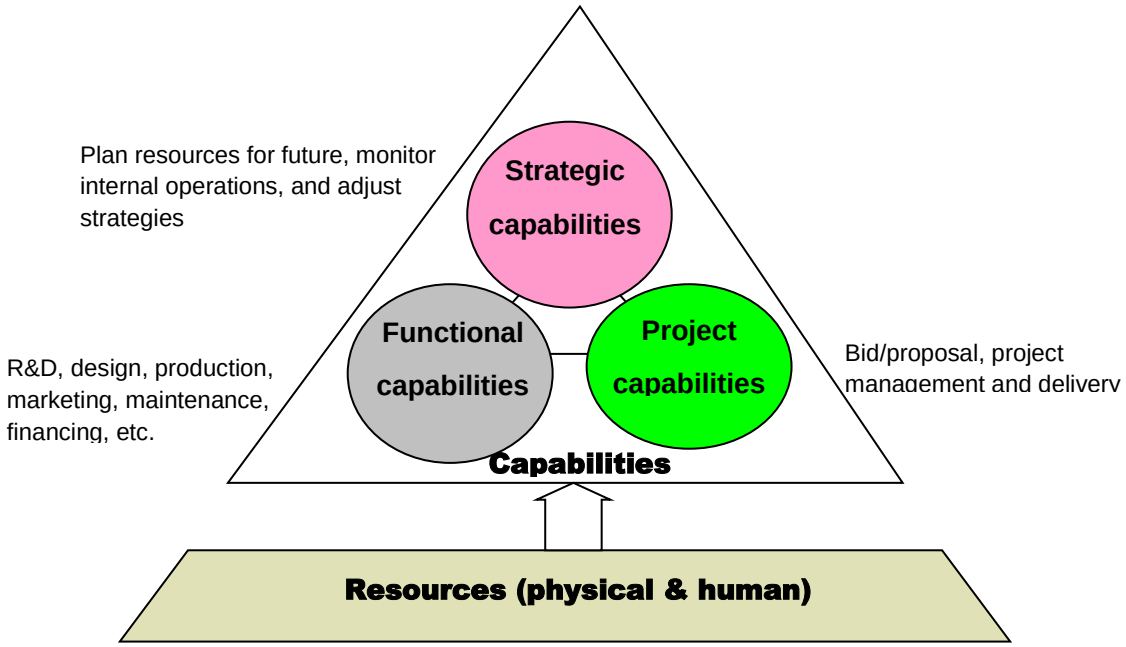
Grant (1995) suggests that 'organisational capabilities refer to a firm's capacity to undertake a particular activity' (p.126), linking capability with activity performed by firms. Winter (2003) links capability with routines, defining organisational capability as 'a high-level routine (or collection of routines) that, together with its implementing input flows, confers upon an organisation's management a set of decision option for producing significant outputs of a particular type' (p.991). Such definitions and approaches to capabilities are still very much related to internal activities, paying little attention to the external and customer environment.

Teece and Pisano (1994) used the expression 'dynamic capabilities' to address the 'key role of strategic management in appropriately adapting, integrating, and re-configuring internal and external organisational skills, resources, and functional competences toward changing environments' (p. 538). They referred to the strategic dimensions of the firm as 'organisational processes, its present position, and the paths available to it' (p. 541). Teece et al. (1997) define dynamic capability as 'a firm's ability to integrate, build, and reconfigure internal and external competencies to address rapidly changing environments' (p. 516). For Eisenhardt and Martin (2000), dynamic capabilities 'include well-known organisational and strategic processes like alliancing and product development whose strategic value lies in their ability to manipulate resources into value-creating strategies' (p. 1118). Their contribution was to identify specific processes like product development and alliancing as dynamic capabilities and link them to value-creating strategies in dynamic environments.

Teece and Pisano (1994) emphasise the strategic and functional capabilities within the firm and its ability to cope with a changing environment, and Chandler (1990) defines organisational capabilities within strategic and functional levels. Within the context of Complex Products and Systems (CoPS), Davies and Hobday (2005) build upon resource-based theory of the firm (Barney, 1991; Penrose, 1959; Peteraf, 1993; Wernerfelt, 1984) and argue that project capabilities were not adequately addressed in this stream of literature.

The project is largely recognised nowadays as an appropriate organisational form to address change and to conduct business (Davies & Hobday, 2005; Frame, 2002, 2003; Kerzner, 2006). One of the reasons for the growth of projects seems to be that the customer-focused or customer-centric approach (see, for example, Galbraith (2005)) in dynamic markets is becoming a necessity in order to remain competitive. Thus project capability has acquired momentum in various instances of project business in various contexts (see, for example, Davies and Brady (2015), Melkonian and Picq (2011), Ghapanchi and Aurum (2012))(2015; Ghapanchi & Aurum, 2012; Melkonian & Picq, 2011). A project can be seen as a dynamic capability (cf. Sicotte, Drouin, & Delerue, 2014; Teece & Pisano, 1994) which acts on resources to change routines (cf. Nelson & Winter, 1982) internally (e.g. within the organisation) or externally (e.g. within the customer). When changing routines externally, the project usually draws resources from various functions from within the firm in order to meet customer's needs (e.g. Pinto & Rouhiainen, 2001). Cross-functionality also happens for internal projects, as demonstrated by Wheelwright and Clark (1992) in the context of various firms (e.g. GE, Kodak and Motorola). On the other hand, projects can influence or be influenced by the firm and customer strategy (see, for example, Cleland and Ireland (2007) and Grundy and Brown (2002)). Thus, the links between strategic, functional and project capabilities, according to Figure 2, are well explored in the literature.

Figure 2 – Resources and Organisational Capabilities



Source: Davies and Hobday (2005, p.63)

Traditional function-oriented firms can expand their project capabilities in order to improve their organisational capabilities to deal with customer demands, and therefore improve their competitive advantage.

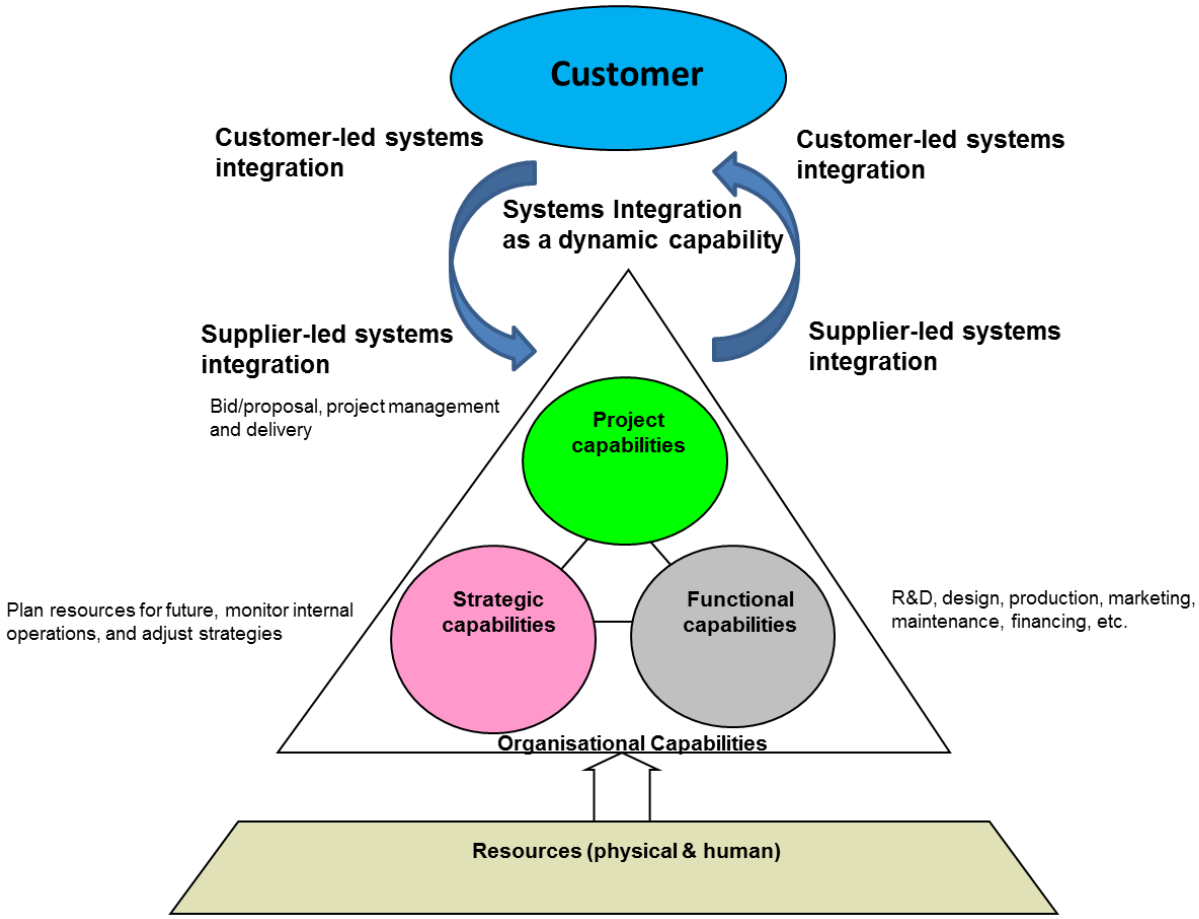
2.3 Analytical Framework

The brief literature review above points out that systems integration can be seen as a dynamic capability to coordinate external suppliers and internal capabilities for the delivery of complex projects over their lifecycle and beyond. This paper considers systems integration as a core strategic capability of the corporation (as of Hobday et al., 2005) and puts forward the issue of under what conditions a customer-led systems integration project is more adequate than a supplier-led systems integration project (through, for example, a prime integrator at the supplier side). Most of the literature addresses the supplier-led systems integration project, and the case study below makes a case study of the major project BT21CN, as a customer-led systems integration project (led by BT as the customer) in order to investigate the challenges and the conditions under which this strategy is favourable. On the other hand, some researchers suggest the integration of customer as part of system integration and into projects and programmes (Liinamaa & Gustafsson, 2010; Voss, 2012) as well as customer involvement in 'defence' projects (Peled & Dvir, 2012). More recently, Hobbs and Besner (2016) raised the issue of differences in practices for projects with internal vs. external customers, and Winch and Leiringer (2016) have highlighted the 'owner project capabilities' for infrastructure development. In this context, the 'owner' is usually the 'customer' of the major infrastructure project (i.e. the entity who is going to operate the infrastructure after the project handover). Following this line, Walker, Davis and Stevenson (2017) suggest ways of coping with uncertainty and ambiguity in infrastructure projects through team collaboration, including suppliers and customers. Finally, Winch and Sanderson (2015) suggest to explore the links between public policy and projects with one of the issues being the meaning in practice of the concept of 'intelligent client' (Aritua, Male, & Bower, 2009). This resonates with the recent report by Le Quesne and Parr (2016), after revisiting recent experience in major capital programmes in the UK, claiming that the approach of having a prime integrator from the supply side has not worked well: hence the need of higher capabilities from the customer side (possibly requiring an 'intelligent client').

A critique to the framework presented in Figure 2 is that the customer is absent. And the customer is a central entity for systems integration (as shown in Figure 1 and in the discussion above). Thus, in order to overcome this drawback, and contrasting Figure 1 and Figure 2, the customer is added to the framework in Figure 2, assuming that project capabilities is at the forefront of systems

integration in order to offer and deploy an integrated solution/system that meets customer requirements. Figure 3 represents these modifications:

Figure 3 – Systems Integration as a Dynamic Capability



Source: Modified from Davies and Hobday (2005, p. 63)

In this framework, systems integration is considered as an instance of dynamic capabilities in tandem with customer needs. Also, the organisational capabilities were rearranged in order to give more prominence to project capabilities as the driver for systems integration capabilities. And although this framework was developed to show the organisational capabilities from the supplier perspective, it is still useful to be used to investigate the organisational capabilities from the customer perspective. Thus, the organisational capabilities known as strategic, project and functional capabilities are going to be used in the next section to structure the case study of BT 21st Century Network (BT21CN).

3 RESEARCH METHODOLOGY

The research was based upon a variant of participant observation in which the author's previous background as a telecommunication engineer and manager allowed him to be recognised by people in the industry as a fellow engineer rather than a social science researcher.[4] In seeking an understanding of telecommunication industry developments by attending trade conferences and

[4] The participant observation was variant in the sense that, although I was attending conferences as I normally did in my previous job, I was not employed by any of those firms, which helped me 'to retain some critical subjectivity about the situation' (Maylor & Blackmon, 2005, p. 236). Thus, the research objectives and the participants' objectives were not co-determined, and had a high level of independence. On the other hand, the participants may be less willing to cooperate or may give less information than expected. I address these issues and how I tried to avoid or overcome them in this Section 3.

interviewing specialists, it became apparent that the major issue for companies was defining the fundamental change needed within the industry and the organisations, namely the traditional telecommunication operators, in order to cope with the shifting competitive environment. More particularly, the fundamental change was concerned with the development of a more flexible infrastructure, and with the rethinking of the innovation processes to create and deliver new services. This change can be translated into a new dominant logic based on platform and solutions, where the customer and the service delivered to the customer are the centre of business practices. The question was not whether incumbent telecom operators needed to change their infrastructure and their innovation processes in services, but how to make these changes in an uncertain and competitive environment carrying a huge legacy system.[5]

NGN was legitimised and adopted by the main incumbent telecommunications operators like BT in the first half of the 2000s (OECD, 2005). At the time of this research, BT intended to complete the transition to NGN by 2011/12 while others, like Deutsche Telekom and France Telecom, would supposedly take longer (completion by 2015 or later).[6] The methodology is primarily qualitative, and the data collection involved conducting interviews and collecting documentation during the period between 2005 and 2008. An important element of the data collection was the attendance at trade conferences in order to interview executives, attend their presentations and gain insights which would not have been possible (or would have taken much more time) by only analysing documents. The interaction between the information obtained through interviews (as primary sources) and through documentation and presentations (as secondary sources) helped to speed up the process and deepen the understanding of the phenomenon.

3.1 Operationalizing the Research Strategy

Being a recent phenomenon, an inductive approach was adopted in three stages. This is in line with what Eisenhardt (1989) calls grounded case study, where theory is built from case study research. Although the author identified some prospective literature in the beginning of the research, it was during and after the data collection that emerging literature could be identified to better explain the data and compare the findings. The research was conducted through interviews and analysis of documents such as reports, newspaper articles and official Internet websites. The reports included annual reports of suppliers and incumbent service providers, and documents of regulators. The interviews were conducted with senior managers, managers and other practitioners of incumbent telecommunications service providers and suppliers, regulators, consultants and market research analysts. An overview of the documentary and interview data used is shown in Table 1.

Stage 1 was the exploration phase where the context of the research problem and incumbent operators were investigated. One of the outcomes of this phase was to narrow the options down to BT as the main case study to be developed. Stage 2 was the phase of exploitation where more information about BT and the industry was gathered addressing the research question on three aspects: platform, service innovation and NGN (Next Generation Network). Stage 3 served to further exploit the insights and propositions reached in phase 2 and attempted to confirm (or not) those propositions.

The interviews were conducted during the trade conferences attended by the author. It was organised a questionnaire with several questions related to this research and during the trade conferences it was adopted the approach to make few questions very focused on the expertise of the interviewee, and wherever possible, pose the same question to many interviewees. All questions were supposed to be covered in one trade conference. Then, whenever possible, received answers were compared with documentary data, trying to confirm (or not) the information thus obtained in the following trade conference. Dubious or ambiguous information was either discarded or considered for a discussion topic. When necessary and possible, previous interviewees were contacted again (by telephone and/or e-mail) for clarification or to obtain more information.

[5] Interview with Deutsche Telekom Technical Manager, March 2005; interview with Lucent Technical Manager, March 2005; interview with Nortel Senior Technical Manager, March 2005.

[6] Interview with BT Senior General Manager, November 2005; interview with Deutsche Telekom Project Manager, November 2005; and interview with France Telecom Technical Manager, November 2005. These different approaches were also mentioned in the interview with KT (Korea Telecom) Business Development Manager, November 2005.

Table 1 – Overview of the research stages for data collection and empirical sources used.

	Stage 1: March 2005 – July 2005 (Exploration)	**Stage 2: August 2005 – July 2006 (Exploitation)**	**Stage 3: August 2006 – May 2008 (Exploitation and Confirmation)**
Objectives	• Understanding industry structure, processes and resources to deliver and build NGN; • Identifying main suppliers of NGN; • Identifying main fixed-line incumbent telecom operators building NGN; • Exploring the dynamics of capabilities development, disruption and inter-firm collaboration.	• Exploring in detail the specifics of industry change in terms of innovation and capabilities development in order to deliver and build the NGN; • Exploring in detail the dynamics of innovation and capabilities development in the transition to NGN of BT21CN, and in BTGS.	• Finalising data collection about the innovation dynamics of the transition to NGN at industry level; • Finalising the data collection about the capabilities development in BT: BT21CN and BTGS; • Resolving remaining discrepancies.
Interviews	Interviews with suppliers, service providers, industry analysts, consultants and regulators: • 7 interviews in CEBIT 2005; • 3 interviews in VON Europe 2005; • 3 interviews in Light Reading Carrier Class Ethernet; • 1 interviews in IEE Course.	Interviews with suppliers, service providers, industry analysts, consultants and regulators: • 2 interviews in Light Reading – The Future of Telecom; • 6 interviews in Carriers World 2005; • 8 interviews in Broadband World Forum Europe 2005; • 9 interviews in ITU-T NGN Focus Group and Industry Event; • 14 interviews in CEBIT 2006; • 16 interviews in 21st Century Communications World Forum 2006.	Interviews with suppliers, service providers, industry analysts and consultants: • 3 interviews in The New Telco: Europe 2006; • 9 interviews in Broadband World Forum Europe 2006; • 5 interviews in IP Leaders 2007; • 14 interviews in C5 World Forum 2007; • 1 interview in Carrier Ethernet Expo 2007; • 3 interviews in ITU –T Kaleidoscope Academic Conference 2008.
Secondary Sources	• Annual reports; • Press releases; • Newspapers and magazine articles; • Official websites; • Trade Conference presentations.	• Annual reports; • Press releases; • Newspapers and magazine articles; • Official websites; • BT Technology Journal; • Trade Conference presentations.	• Annual reports; • Press releases; • Newspapers and magazine articles; • Official websites; • BT Technology Journal; • Trade Conference presentations.
Trade conferences involved in	• CEBIT 2005; • VON Europe 2005; • Light Reading - The Future of Carrier Class Ethernet 2005; • The IEE Annual Course on Telecoms NGN.	• Light Reading - The Future of Telecom – Europe 2005 (07-08 Sept 2005); • Carriers World 2005; • Broadband World Forum Europe 2005; • ITU-T Focus Group on NGN 2005; • CEBIT 2006; • 21st Century Communications World Forum 2006.	• The New Telco: Europe 2006; • Broadband World Forum Europe 2006; • IP Leaders 2007; • C5 World Forum 2007; • Carrier Ethernet Expo 2007; • ITU-T Kaleidoscope Academic Conference 2008.

Source: Author's elaboration

The list of firms and organisations to which interviewees belonged is as follows (numbers in parenthesis represent the number of interviewees in the firm/organisation):

Telecommunications Network Operators (Total 57 interviews)
AT&T (1), Belgacom (1), BT (32), C&W (1), Deutsche Telekom (6), France Telecom (5), KT (Korea Telecom) (1), NTT (2), Portugal Telecom (1), Swisscom (1), Telecom Italia (2), Telefónica (2), Telenor (1), THUS (1).
Suppliers (Total 42 interviews)
Alcatel (5), Ciena (1), Cirpack (1), Cisco (4), ECI (1), Ericsson (4), Fujitsu (4), Huawei (3), IBM (3), Juniper (2), Lucent (3), Marconi (1), Nortel (2), Siemens (5), Sonus (1), Veraz Networks (1), ZTE (1).
Regulator (Total 1 interview)
Ofcom (Office of Communications) (1).
Market Research (Total 4 interviews)
Heavy Reading (1), Light Reading (1), Ovum (2).

The methodology was primarily a qualitative case study, and the data collection involved conducting interviews and collecting documentation during the period between 2005 and 2008 with further follow-ups and updates done by 2015. An important element of the data collection was the attendance at trade conferences in order to interview executives, attend their presentations and gain insights which would not have been possible (or would have taken much more time) by only analysing documents. The interaction between the information obtained through interviews (as primary sources) and through documentation and presentations (as secondary sources) helped to speed up the process and deepen the understanding of the phenomenon.

3.2 Data Collection and Analysis

The data collection was mostly based on interviews and secondary data. The rationale behind the interviews was the following. I had a basic questionnaire with the topics related to the three dimensions of the research (technology, organisation and customer) and identified the interviewees before attending the trade conferences. I targeted the interviewees depending on their areas of expertise, as described in the folders of the trade conference. I identified some other interviewees during the trade conference itself, and I was also referred to other interviewees for topics that were different from the expertise of the interviewee I initially contacted. The interviews lasted from 15 to 50 minutes, and they were not recorded due to practical reasons and the dynamic nature of the environment. I took notes of the interview immediately afterwards, writing down as many details as possible. From conference to conference I tried to refine my questions and ask different questions depending on the findings of the previous conferences, and my own research on the secondary sources up to that moment. When I approached an interviewee, I usually had a notion of what he/she was expert on (because there was a brief description of their resume in the folders of the trade conference and/or because of the theme of their presentation and/or because of their position in the booth, demonstrating a particular system or equipment in the exhibition.

I organised all the interview data according to the logics or dimensions of the theoretical framework: technology, organisation and customer. Thus, I tried to see patterns, connections and 'the whole picture' (as the interviews were supposed to show me the pieces). I separated the evidence into three basic categories: consensus (not ambiguous information or common sense), contested (ambiguous and conflicting opinions about one subject) and unknown (issues not understood or that did not make sense or that I could not understand at that moment). Using this interview framework, I followed the same procedure with the other empirical secondary data I obtained (presentations, reports, etc.), building tables and organising the material into consensus, contested and not understood categories. I then tried to connect them with the interview data and build a complete picture, bearing the research question in mind. This was refined from conference to conference, following the stages presented in Table 1.

In order to improve the validity of the empirical data, I used informants and documentary sources from various perspectives: not only incumbent operators, but also suppliers, regulators, market research analysts and competitive operators (new entrants, for example). I also repeated the same question or referred to the same issue with many interviewees with the aim of confirming or identifying inconsistencies.

During and after the presentations in conferences, I posed questions that were specifically relevant to my research. After reviewing some empirical evidences, I also contacted some interviewees with specific questions and doubts. In order to refine my understanding of the main issues and to refine my questions in subsequent interviews, I used other interviews available in the press and specialised websites like telecomtv.com and lightreading.com. I also attended many presentations about the subject in trade conferences and through 'webinars' where I had the opportunity to participate in informal conversations and to pose questions.

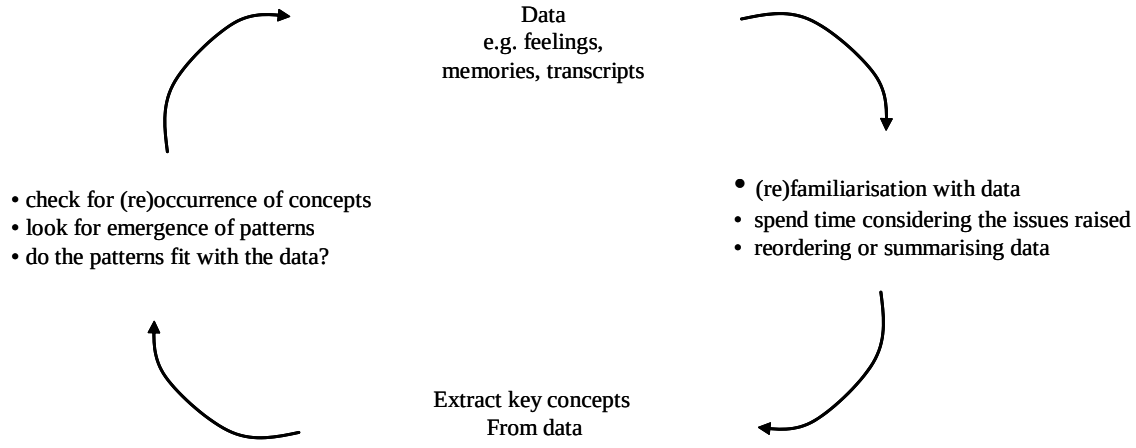
The methodological approach I used was based heavily on attending trade conferences and

analysing secondary data in order to sharp my perceptions on the most important issues concerning the transition to NGN, and also to get contacts in the industry for interviews and to indicate other people for interviews. As pointed out by Hersent, Petit & Gurle (2005, p. xxxi) 'during [the telecom bubble] it seems that many manufacturers and many service providers forgot that telecommunications is a science, and more and more strategic or even technical decisions have been made based on misleading market campaigns'. They repeatedly state that 'in fact even today, almost 100% of what we read in telecom magazines or hear in telecom tradeshows is plain advertising, not only inexact technically, but too often presenting conclusions that are the exact contrary of what any sound technical analysis would lead to' (p. xxxi). Taking this into account, the marketing bias of the tradeshows I attended was evident. In this environment, there is little authentic debate or criticism and it would not have been appropriate to introduce such debate or criticism in the course of *in situ* interviews in this environment. So, my task was to reduce this 'marketing effect' and try to distil and confirm information through the use of other sources, either documentary or through interviews.

The analysis was performed simultaneously with the data collection, i.e. not only after collecting all the data. This is in line with what Dawson (2006) says when analysing qualitative data: 'the researcher might analyse as the research progresses, continually refining and reorganising in light of the emerging results' (p.112). As the case study has multiple sources of information, it is possible that data collection and analysis may overlap (Maylor & Blackmon, 2005). In this sense, for example, the analytical framework emerged as a result of the interaction between the data and the refinement of the literature in the intermediate stages of the research. The writing of the cases was also in parallel to the analysis of the data, and several papers were generated and presented to conferences in the meantime. My participation in academic conferences presenting portions of this work also helped me to refine the research. I also used some trade conferences to discuss with interviewees findings of the papers presented in academic conferences.

The process of data collection and analysis performed in this research can be summarised using Kolb's learning cycle (Kolb, 1985). Figure 3.3 shows four stages of the cycle (Maylor and Blackmon, 2005): (i) concrete experience, where the researcher captures data and perceives reality through feelings, memories, transcripts, etc.; (ii) reflective observation, where the researcher familiarises and refamiliarises with the data, thinks about the issues emerging from the data, and reorders and summarises the data; (iii) abstract conceptualisation, where the researcher extracts concepts (a descriptor for certain patterns) from the data; and (iv) active experimentation, where the researcher identifies patterns emerging from the data, and whether the data fits into the literature reviewed so far (this stage may be particularly important if it is necessary to redefine the literature which best fits the data).

Figure 3.3 – Kolb's Learning Cycle Applied to Qualitative Data Analysis



Source: Maylor and Blackmon (2005, p. 348)

Although this process is presented as a cycle that suggests some sequential steps, in practice the research followed an interactive approach among the stages. Also, this learning cycle can be compared to the stages described in Table 1, where concrete experience can be mostly related to stage one (exploration), reflective observation and abstract conceptualisation to stage two (exploitation), and active experimentation to stage three (exploitation and confirmation).

4 SYSTEMS INTEGRATION IN THE MAJOR PROJECT BT 21ST CENTURY NETWORK (BT21CN)

Using the framework of Figure 3 from the literature review, this case study investigates systems integration capabilities and its overall impact on organisational capabilities from the customer perspective.

BT21CN is a major project that BT decided to establish in order to build its Next Generation Network (NGN) to deliver business transformation.[7] The NGN is supposed to be a network platform where both the reuse of sub-systems or interfaces and the openness to external parties for industry innovation are present. This section shows the process that led to the selection of BT equipment suppliers for this specific major project based on the architecture chosen for BT21CN. It introduces the context of systems integration in BT21CN, examining the reasons for BT to assume the role of prime integrator in the project and showing that systems integration capabilities were stretched by the complexity of BT21CN. Following the framework of Figure 3, the sections below address strategic capabilities (Section 4.1), project capabilities (Section 4.2) and functional capabilities (Section 4.3), before the analysis in Section 5.

4.1 Strategic Capabilities: Planning for the future

The strategic capabilities relate predominantly to the way BT positioned itself before actually starting the activities to undertake BT21CN. This major project was announced in June 2004, although its history can be traced back to 2001 when a new BT chairman was hired, Sir Christopher Bland, who came from BBC (BT Consultant, Interview, November 2005). The main problem for BT at that time was a huge debt of around £28 billion. Sir Christopher Bland prepared the company to receive new people and in 2002 a new CEO was hired, Ben Verwaayen, who arrived from Lucent Technologies. He had previously worked for KPN (the incumbent telecom operator in the Netherlands) and ITT (a supplier of telecommunications systems). Also, a new CTO was hired, Matt Bross, who came from the US telecommunications operator Williams Communications. Ben Verwaayen seemed to have brought a more aggressive leadership style to the table in terms of doing things faster and more decisively. He also seemed to be more open to radical approaches (BT Senior Manager, Interview, November 2005). Another characteristic was that he worked to consolidate BT. In the past, BT's business units (i.e. Ignite, BTopenworld, BT Wireless and Yell) were considered as autonomous businesses to be sold separately to the market (BT Senior Manager, Interview, March 2006). Verwaayen's unified view of the firm was opposed to the idea that BT was effectively a conglomerate with detachable parts.[8] Market analysts suggested the break-up of BT during the debt crisis and OFCOM (Office of Communications)[9] seemed to be in favour of splitting BT into parts in order to enhance competition in the British telecommunication service market (OFCOM Manager, Interview, July 2005).

Ben Verwaayen was completely opposed to such strategies, arguing that it is necessary to apply innovation in telecommunications end-to-end and that the break-up of BT would reduce its value and competitiveness in the market (BT Senior Manager, Interview, March 2006). Eventually, BT agreed with OFCOM (Office of Communications) to create a new division called Openreach, a spin-off of BT Wholesale that would give equal treatment to BT Retail and other service providers.

Ben Verwaayen then worked to consolidate what remained of BT and presented 'One BT' to the market, starting even within his office, where he shared a single room with the directors, having physically removed the walls (BT Consultant, Interview, November 2005). There was a time where the 'divisions' competed with each other, offering separate proposals to customers. Each division had its own profit/loss account without worrying too much about the company as a whole, or other divisions (BT Consultant, Interview, November 2005). In contrast, Verwaayen seemed to be more concerned about articulating a clear vision for the overall BT corporate entity and strategy, and

[7] For this paper, NGN is viewed as 'a multi-service network based on IP technology' (OECD, 2005, p. 7). It is based on the premise that voice, video and data services are digitalized and transported using packet-switching technology based on the Internet Protocol (IP).

[8] Notable examples of conglomerates are GE and EasyGroup. Further discussion on conglomerates and unified view of the firm can be found in Doz and Kosonen (2008).

[9] OFCOM (Office of Communications) is the communications regulator in the UK.

communicating it to customers and shareholders (BT Consultant, Interview, November 2005). With Matt Bross the CTO Office appears to be better coordinated in terms of unifying the architecture and the approach to innovation (BT Consultant, Interview, November 2005). It seems apparent that one concern of the new top management was to consolidate BT into a single organisation. As Bross (2003) put it:

> To paraphrase Ben Verwaayen, the vision is for a transformation of BT from the 'schizophrenic, many-headed, behemoth' of today to a company perceived as a trusted ally in daily life. With a company the size of BT there is massive inertia holding back such a metamorphosis, therefore the biggest problem lies in actually implementing it.

The fragmented condition of BT was a major concern, and the greatest challenge of BT21CN was not technological, since the technology was already available to realise the architecture. The challenge was to overcome the inertia to implement the architecture (BT Manager, Interview, September 2005), which required changing the mindset of people to change the 'modus operandi' from PSTN to NGN (BT Senior Manager, Interview, March 2006). BT had set the aims of better customer experience, shorter time to market for service provision, and lower capital and operational expenditure. They soon realised that these aims could not be achieved with the current methodologies and processes (Reeve, Bilton, Holmes, & Bross, 2005). As network operators can buy their systems and equipment from the same suppliers, such network operators have the same access to technology as their rivals (Fransman, 2002). The technology being deployed in BT21CN has been deployed elsewhere or is available to other operators (BT Senior Manager, Interview, October 2005). Therefore, the differentiation and competitive edge of telecom operators like BT lies not in the technology itself, but in how they use the technology to achieve their strategic aims.

The decision to proceed with BT21CN involved some major influences that may not be easily captured if the analysis is made only after the official start of this major project in 2004. The huge debt of BT at the beginning of the 2000s created some malleability for change. BT people were aware that some change (maybe radical) was needed and they were more open and willing to accept it and cooperate (BT Senior Manager, Interview, March 2006). The new CEO was also keen to consider or adopt some radical change (BT Senior Manager, Interview, October 2006). Coming from Lucent, he was supportive of initiatives that favoured standardisation and avoided proprietary solutions (BT Consultant, Interview, November 2005). Everyone at that time was talking about IP anyway. It was already recognised that IP (in conjunction with MPLS) had the capability to be the common protocol for converged voice, data and video services (BT Manager, Interview, October 2005). Another factor was that the new CTO, Matt Bross, was 'excellent at putting complex things simply and selling up' to the board (BT Senior Manager, Interview, March 2007). One interviewee said that probably 'Matt's skills, drive and charisma were a deciding factor, even though he had great support from Ben' (BT Senior Manager, Interview, March 2007). At least for BT, it is apparent that the two newcomers in the top management positions exerted a decisive influence for radical change. Also, the debate between consolidating and splitting up BT may have been a decisive factor in Christopher Bland's choice of Ben Vervaayen, instead of promoting someone from BT to continue the break-up of the company.

The fact that BT decided to proceed with the migration at a faster pace than other incumbents in the world makes them a first mover in the scale and scope of their NGN implementation, which represents a unique opportunity to explore the NGN commercial and technological environment from which lessons for future and ongoing deployments of the same nature may be learned. The commitment to this project is evident, as BT claims that it is necessary for them to switch off the PSTN network as soon as possible because the cost of running two parallel networks would be disruptive for BT operations and capabilities. BT claims that they are going to save about £1 billion per year from 2008/2009 as a result of the rationalisation of the network.[10]

The historical account above shows the influence of the renewal of the top management in BT, where external staff was hired, and internal staff were not promoted. This decreased the barriers for more radical change and it explains, in part, why the large project of BT21CN came to be seen as the key action taken to make the transition to NGN. These events happened before BT21CN officially started in 2004, and demonstrates how particular events and contextual issues lead to the formation of major projects. In particular, the huge debt and the sale of the mobile business forced BT to move quickly through BT21CN. Such events help to understand how the BT21CN project was shaped, the particular

[10] This claim is made in the BT press release on 09th June 2004, announcing officially the plans for BT21CN. And the claim was repeatedly propagated in trade conferences, such as the Supercomm 2005 in Chicago, on 06th June 2005 by Matt Bross, BT CTO.

factors that may lead the project to success (or failure), and the decisions taken for its execution. Once BT decided to execute the project, one major issue they faced was the choice of architecture to be adopted that would guide the transformation of the whole network. Therefore, after the strategic considerations and capabilities involved, it came the project capabilities mainly represented by bid and project management.

4.2 Project Capabilities: Bid and Project Management

The BT21CN major project had a procurement stage before the execution of the project really began, where potential suppliers and BT discussed and defined their needs and conditions. In a similar fashion to projects aimed at delivering complex products and systems[11], the starting point was the tender process that led to the selection of preferred suppliers. BT divided the tender process into four stages (Green, A., Presentation, 2006): (i) pre-ITT (Invitation to Tender) from January 2003 to June 2004; (ii) formal ITT (July 2004); (iii) short listing and negotiation (July 2004 to March 2005); and (iv) supplier selection (April 2005 to March 2006).

Eventually eight suppliers were selected: Alcatel, Siemens, Cisco, Fujitsu, Huawei, Lucent, Ciena and Ericsson. Four contracts were signed in December 2005, and the other four between January and March 2006.[12] The radical and pioneering announcement of the investment of £10 billion over five years allowed BT to negotiate very tight commercial conditions with suppliers. The argument was that as the suppliers were going to sell to BT, and it was the first major project in the industry, they would be 'enabled' to sell to other telecom operators, and a significant share of this added value should be offered as discounts to BT.

BT chose to divide the network into five parts and chose at least two suppliers for each part, except the I-node, which is the intelligence of the network and was granted to Ericsson alone.[13] Although the tendency would be to work with one prime contractor acting as the system integrator, no single vendor would take the risk to supply the whole network (Sonus Senior Sales Manager, Interview, May 2005; Alcatel Manager, Interview, May 2005; Ericsson Senior Technical Manager, Interview, October 2005; Ciena Sales Manager, Interview, March 2006). Thus a considerable work of project management and systems integration needs to be done within BT. That is the reason for the creation of the BT 21st Century Network (BT 21CN) transformation project.

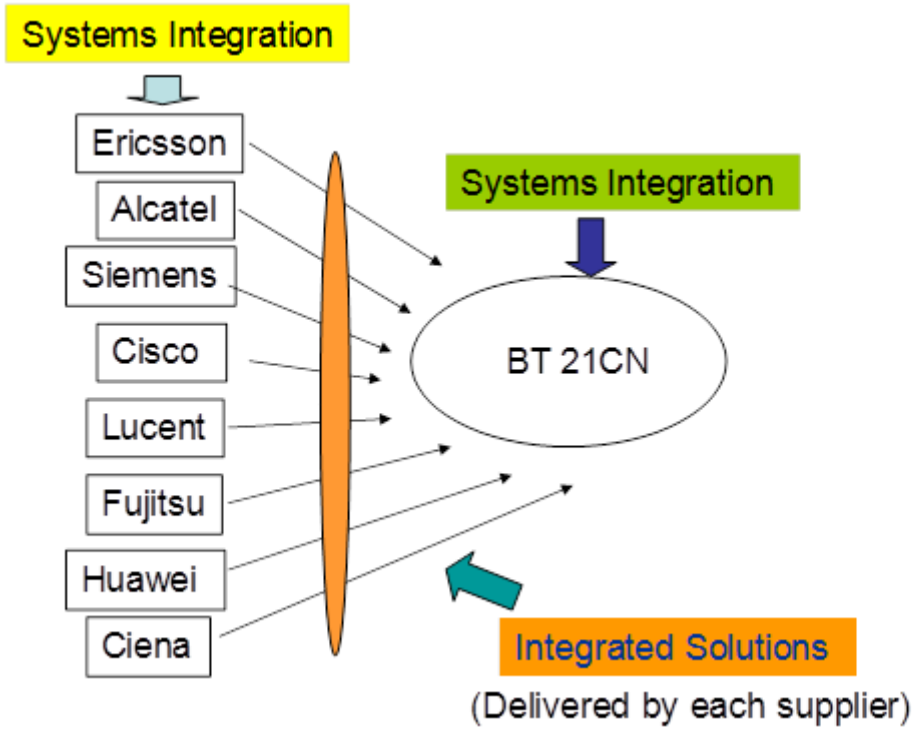
An overview of the preferred suppliers of BT21CN is shown in Figure 4. It shows the preferred suppliers delivering their system solutions to build BT21CN, and the two instances of systems integration associated: (i) at the supplier level, where they need to integrate their own products and services for delivery; and (ii) at the customer (i.e. BT) level, where all the integrated solutions of several suppliers (which can be competitors in other projects) are integrated among themselves and with BT's network. This paper is concerned with systems integration at the customer (i.e BT) level, with BT assuming the role of prime integrator.

Figure 4 –Two Levels of Systems Integration for BT21CN

[11] Complex Products and Systems (CoPS) are defined as 'high cost, engineering-intensive products, systems, networks and constructs' (Hobday, 1998, p. 690). CoPS are usually highly customised, require skills across a variety of disciplines, and are produced in small batches or in one-off modes for business-to-business transactions and relationships (Hobday, 1998, Hobday et al., 2000, Davies and Hobday, 2005).

[12] BT issued a press release on 28th April 2005, announcing the preferred suppliers.

[13] From the same BT press release on 28th April 2005.



Source: Author's elaboration

The first level of systems integration occurs on the supplier side, where they produce the products and associated services that will meet BT's needs for the project. BT21CN can be considered as the locus of systems integration of the systems solutions delivered by BT's equipment suppliers. In line with previous research done by Davies et al. (2007), complex organisational forms have emerged, combining both systems selling and systems integration, and both modular and proprietary integrated systems (Brusoni, 2005; Brusoni & Prencipe, 2001).

4.2.1 Project Management: Integrating the Integrated Solutions

Given the previously noted scale and complexity of BT21CN and BT's decision to be the prime integrator, the first level of integration is insufficient. BT has decided not to delegate the final integration to a prime contractor (from the supplier side), but BT assumed the systems integrator role for itself. One reason for BT to assume the systems integrator role was the fact that BT did not want to be a 'passive' participant of the process, mostly observing others doing the job (BT Manager, Interview, March 2007). BT wanted to be in a position to actively learn about the process of network transformation, to apply such learning in other further projects, and to even commercialise project capabilities to other BT customers. Another reason is that as the project is budgeted at £10 billion, it would be very difficult to leave one prime integrator to assume the risks of such a role (Sonus Senior Manager, Interview, May 2005). A third reason (that is somewhat controversial) is that BT, having at the start of the BT21CN project around 100.000 employees, felt it was necessary to continue providing jobs for most of them (Sonus Senior Manager, Interview, May 2005). Outsourcing the role of systems integrator/prime contractor would decrease the need for additional people at BT (or even reduce the justification for existing ones) and this could lead to layoffs and problems with the regulator, labour unions and government.

As BT does however have an interest in learning how to build the system, it is acting as the prime integrator, and negotiating directly with the eight system suppliers. Evidence of this interest in learning (and subsequently commercialising this learning) is the launch of the '21C Global Ventures' initiative in December 2006, which offers to other telecom operators the benefits from BT21CN lessons already learned.[14] The aim of this initiative is to sell

[14] Paul Reynolds, CEO BT Wholesale, introduced BT's 21C Global Venture at the ITU Telecom World in Hong Kong on 05th December 2006.

the BT21CN know-how delivered by lead consultants, lead engineers, techno-economists and programme managers. The know-how includes expertise in network migration issues; network design, development and testing; network implementation and build; vendor management; and techno-economic modelling (BT Senior Manager, Interview, March 2007). BT claims that they have knowledge and experience of what it takes to reduce operational and financial risks; of end-to-end innovation on people, processes and systems; of vendor capabilities and new ways of working with them; of the opportunities of industry regulation and the important benefits of standards; and of the totality of convergence (implementing and selling the concept of convergence) (BT Senior Manager, Interview, March 2007). Despite these claims, BT's capacities to assess and resolve technical issues in BT21CN were considered limited, as BT was the slowest link in the value chain (BT Senior Technical Manager, Interview, March 2007). This expressed that BT was a 'bottleneck' in the project, slowing down its progress. BT saw many advantages in assuming the role of systems integrator, however the suppliers were criticizing BT for not being quick enough in raising and solving the issues related to the systems integrator role..

This section examined the BT21CN as the systems integration of system solutions delivered by BT's suppliers. BT assumed the role of prime integrator of the preferred suppliers. In order to integrate the system solutions of the suppliers to build BT21CN, besides project capabilities, BT needs to rely on some functional capabilities which are examined in the following section.

4.3 Functional Capabilities in BT21CN

BT has been working in a multi-vendor environment for many years. This is because BT has been taking the market approach for a long time, as opposed to other incumbent operators, such as NTT and AT&T in the past, who relied on a small number of suppliers and worked closely with them (Fransman, 2002). One of BT's functional capabilities seems to be multi-vendor management (BT Senior Manager, Interview, March 2006). However, one skill that BT still needs to learn is to debug end-to-end services in a multi-vendor environment (BT Manager, Interview, March 2007). This is one of the NGN capabilities that operators like BT need to develop as equipment and systems become more complex, with more functionality. The suppliers do part of the multi-vendor management by themselves. However, BT had to push it further establishing laboratory system testing and field trials (further developed later in this section) to enforce the collaboration among suppliers and validate the solution before it was deployed in the field at the scale required.

4.3.1 Multi-vendor integration

Multi-vendor integration is BT's core competence (BT Senior Manager, Interview, March 2006), creating a robust functional capability relying on various external suppliers from the market for many years. What seems to be different with the multi-vendor integration for BT21CN is the scale and scope of the project. Suppliers are reporting that their main challenges are (i) the absence of a prime integrator; and (ii) the need to share their system/product roadmap with other vendors who are competitors in different markets (Ericsson, Huawei and Fujitsu Senior Manager, Interviews, March 2007). Also, as the project is so large, in practice there are many people 'in charge' and it is frequently very difficult to raise the issues and to get things done (Fujitsu Senior Manager, Interview, March 2007). In addition, the realisation has dawned that the quality of the project is limited by the quality of people you get (Fujitsu Senior Manager, Interview, March 2007). The quality and competence of people becomes a recurrent topic, as the jobs require higher levels of cognitive skills, talent and psychological profiles.

The multi-vendor integration was made more difficult as vendors needed to deal with a legacy network that was twenty years old. In the process of replacement, many problems emerged without being expected and re-planning needed to be done. It was not a like-for-like replacement of functionality, i.e. BT21CN is about replacing the components (e.g. routers, multiplexers, which are complex products and systems themselves) and changing the way they are connected, i.e., their architecture (Juniper Technical Manager, Interview, March 2006; Telefónica Senior Technical Manager, Interview, October 2006; France Telecom Senior Technical Manager, Interview, October 2006; Cisco General Sales Manager, Interview, March 2007). New components (e.g. IP routers with different and greater functionalities than previous telecom switches) allow simpler and more robust architectures that enhance the flexibility of the network which in turn allows more flexible services with new business models to be created.

In order to deal with the complexity of the technology and project, BT decided to establish an integration laboratory to work with the vendors, who usually do not communicate naturally with each other (BT Senior General Manager, Interview, March 2007). Although laboratory validation and field trials are normal procedures in the telecommunications industry, the large scale and scope of BT21CN required special attention and

further functional capabilities needed to be developed.

4.3.2 Small within Big – The Role of Lab Validation and Field Trials

The size and complexity of the BT21CN project required a different approach for the laboratory validation and field trial in terms of organisation of resources and people, and of capabilities development. The validation of the solution of the different vendors was a challenge that involved issues like: collaboration, information sharing, standards interpretation, fault isolation, root cause analysis, rapid resolution and validation through regression analysis (BT Technical Director, Interview, March 2007). These issues are not completely new in the telecom industry. What is new, however, is the scale, scope and timeframe against which this solution needs to be deployed.

The testing environment seems to be overwhelming. There are eight preferred vendors trailing over thirty vendors behind them (BT Senior General Manager, Interview, March 2007). The eight vendors are the Tier 1 suppliers, and the trailing vendors behind them are called Tier 2, Tier 3, and so on, as long as the position of the vendor in the supply chain is towards the upstream. This type of global supply chain is the first that BT is undertaking in its history. This includes the migration of user applications and users; the support for future protocols and applications; and working around new and evolving standards (BT Senior Technical Manager, Interview, March 2007). From the validation process above, the fact is that learning occurs a lot more when there are real customers plugged into the solutions rather than in the laboratory (BT Senior Manager, Interview, March 2007).

BT, as the prime integrator, needs to intervene and 'force' collaboration among the vendors. 'Collaboration does not come naturally in this industry' (BT Manager, Interview, March 2007). It is expected that the vendors collaborate, but frequently they do not, so BT created the validation environment, including lab and field trials (BT Senior Manager, Interview, March 2007). For the vendors the question (made by BT) is 'did you do your part *and* ensure end-to-end integration?'. Thus each vendor needs to be concerned with their part *and* the whole at the same time and that is a significant difference from the past in terms of compartmentalised practices and mind-set. Vendors need to be prepared to exercise substantial rationality.

The 'test factory' is based largely on automated capabilities. Structured methodology and processes are used and the principle is 'to learn how to fail quickly in order to learn faster' (BT Senior Technical Manager, Interview, March 2007). The aspects of learning (and hence the quality of people) and building trust seem to be major concerns in the BT21CN project.

This highlights the systems integration capabilities used to build BT21CN and draws attention to multidisciplinary work of functional areas where multi-vendor integration requires further capabilities development in laboratory validation and field-testing. The existing systems integration capabilities were not adequate due to the scale and scope of the project. In the following section, the customer-led systems integration and its impact on organisational capabilities are discussed.

5 CUSTOMER-LED SYSTEMS INTEGRATION PROJECTS AND ITS IMPACT ON ORGANISATIONAL CAPABILITIES

Although IP/MPLS is not a new technology for the incumbent operator and is not a disruptive technology (cf. Christensen, 1997), the level of engagement of the user (BT) in the early life cycle may be deeper than is normally encountered in other major projects. BT has a deep interest in learning about the technology and systems implementing it as BT decided to assume the responsibility of the systems integration. Besides that, suppliers for this project are competitors in other markets, and natural competition and unnatural cooperation calls for cooperation in the early stages of the project in order to build trust.

Although systems integration and project management were capabilities already existing in BT, they were in a level of development that was not enough for undertaking BT21CN due to its unprecedented complexity. Section 4 illustrated many aspects of the complexity that BT is facing to develop such capabilities, as there was no benchmark that BT could use as a reference. Therefore, most of the capabilities development needs to be done 'on the fly', as the project evolves. The next sub-section (Sub-Section 5.1) examines the impact of the development of the capabilities for BT21CN on the firm as a whole.

5.1 Developing Organisational Capabilities through BT21CN

The success of BT21CN depends not only on BT´s capability to build the convergent network but also on what Mansell and Steinmueller (2000) call 'understanding the factors influencing the rate of market development' (p. 103) and how to address it: once the network is built, how to make the customers adopt the new services, and how BT and its ecosystem generate new services for the market and appropriate the rents. Roberts and Fusfeld (2004) point out five critical work functions for innovative projects: idea generating; entrepreneuring or championing; project leading; gatekeeping; and sponsoring or coaching. They argue that 20-30% of the work is related to those critical roles (unique skills performed by relatively few people). The other 70-80% is about technical effort based on routine problem-solving tasks. From the discussion above, in BT21CN, it seems that the roles that are missing or need improvement are mainly related to project leadership as BT is the prime integrator and suppliers are struggling with the absence of a nominated 'integrator' (Ericsson Senior Manager, Interview, March 2007). The other role that needs improvement is gatekeeping, for the interface between design and testing as it is shown in Section 4.3.2.

Routines, understood as processes inside companies, are certainly changing during a major transition like this. The real challenge is not the technology itself, but what takes time in the transition is to change the internal processes that were established in the PSTN context and which have been reinforced for many years (Deutsche Telekom Manager, Interview, March 2005). Another interviewee said that the main challenge is to change peoples' minds, which are focused on the PSTN processes (BT Senior Manager, Interview, November 2005). In BT´s transition to NGN, routines are being changed due to technological change, from circuit-switched PSTN to packet-switched IP (Internet Protocol) technology. These routines are related to the operation of the infrastructure. However, the transformation of the network implies a modification of the current relationship with customers and the provision of services. Thus, routines are not only changing for internal operations, they also must change to address the interface with customers and third party firms that may use BT infrastructure to provide new services. By assuming the role as prime integrator of BT21CN, the effect was the acceleration of change in routines and of the development of organisational capabilities.

5.2 Accelerating the Development of Organisational Capabilities through BT21CN

Taking into account the framework of strategic, project and functional capabilities proposed by Davies and Hobday (2005) and transporting it into the context of BT, these three capabilities are very strongly present in the transition to NGN and it seems that they have different intensities over time. The decision making process of the transition needs a strong strategic capability, and the decision to invest £10 billion over about five years was certainly not an easy one. Coincidentally, the announcement of BT21CN was made a few years after the top management (CEO and CTO) of BT was changed, and top managers outside BT took over. This certainly had an impact on BT´s top management dominant logic and influenced the decision to approve the BT21CN project.

The project capability is manifested through the establishment of the BT21CN Project (bid and project management). During the transition, BT needs world-class project management skills, within which communication skills are a major component (BT Senior Manager, Interview, March 2007). BT21CN certainly moves BT to a new technology base, however it does not seem to move it to a new market base in the domestic market, as major customers being addressed are still its mainstream customers. However, the way to address these existing customers is significantly different. BT21CN makes it possible for BT to expand its market base globally from a common and robust network.

Along the road to transition to NGN, capabilities are transferred to functional departments, which will carry out the daily activities of maintaining and upgrading the network in following an evolutionary way. Projects of a smaller scale may be set up to address specific problems, but not on the same scale and scope of BT21CN. The lean operator that is expected to emerge after the BT21CN project has been implemented is due a major optimisation of BT´s functional capabilities, where BT is expected to make cost reductions in operational activities.

The BT21CN project and BT's decision to take the role of prime integrator of the systems solutions delivered by the preferred suppliers accelerated the development of BT's organisational capabilities to address the changing communications market, thus enabling BT to respond faster and more flexibly to demands from customers. Increasing the amount of external relationships and the capability to establish and maintain those relationships seem to be more and more important as BT21CN evolves. This is a situation different from previous technological changes suffered by the incumbent fixed-line telecommunication operators, who were

more focused on expanding and improving their network capacity.

In summary, the strategic, project and functional capabilities interact during the transition to NGN, but they are required with different intensities over time: at the beginning of the transition, strategic capabilities need to be strong in order to decide to make the transition and set the goals and principles of the transition strategy. Once a decision has been taken to make the transition, it is necessary to implement the strategy, and that is where project capabilities become more important or 'intense' (with BT establishing the BT 21CN Project for the transition). At the final stages of the transition project, functional capabilities again become more intense, and new capabilities are transferred to existing and new functional activities. BT21CN is a project whose outcome is an IP/MPLS network which is expected to be a catalyst for the organisational capabilities to be changed and/or developed within BT.

6 CONCLUSION

Complex systems integration projects are usually approached from the supplier perspective. The role of prime integrator, as a supplier/contractor which is solely responsible for the integration and communication with a major customer, is common in various industries such as construction and military. The main advantage for the customer is to push risks to the supplier, and the customer assumes a more passive position to just accept the project and 'turn the key'. This imbalance in risk taking may lead to a lack of checks and balances, resulting in underestimation of time and cost, and overestimation of benefits, very common in major projects (see, for example, Flyvbjerg et al., 2003). More recently, Infrastructure and Projects Authority (IPA) in the UK warned about the difficulty of transferring the delivery responsibility of major capital programmes to a single 'prime contractor' in the private sector (Le Quesne & Parr, 2016).

This paper discussed the customer-led systems integration project and its impact on the development of customer's organisational capabilities. The case of BT21CN showed that there is much more commitment from the customer to make the project happen in collaboration with its suppliers. Many processes related to multi-vendor integration and laboratory validation were put in place in order to create an environment for collaboration and commitment to an end-to-end solution that could satisfy BT. This collaboration is frequently very conflicting, as suppliers were competitors in different markets and projects, at the same time they were collaborators for BT21CN. The relationship with suppliers is not only a supplier-customer one, but it is a long-term partnership which requires a strategic alignment of the eight vendors and BT in order to technologically maintain and evolve the network (BT21CN).

BT, as the customer, developed project, systems integration and organisational capabilities that can be re-applied within its organisation, and even commercialised to other firms that are intending to transform their telecommunications and/or IT (Information Technology) network in large scale. The customer-led systems integration approach made BT to have higher commitment with the BT21CN project, assuming more risks, and probably leading to a better project performance, although in many instances BT recognised itself as the slowest link in the value chain. This approach made sense to BT as a customer in order to develop organisational capabilities that could be a competitive advantage in terms of operational improvement and creation of new business.

6.1 Suggestions for Future Research

Suggestions for future research are concerned with the decision-making of top management related to the 'locus' or role of systems integration in their projects, and its effect on the development of organisational (mainly project) capabilities usually addressed by the capability maturity model (e.g. Konrad et al. (1996)) and project management maturity model (e.g. Kerzner (2006)). These models deal with the development (maturity) of capabilities usually through a staged module with 5 (five) levels of maturity. Little attention is paid to the way the context can play a major role in changing the rate (e.g. acceleration) of maturity, on the types of projects that the firm undertake, and on the role of the firm as systems integrator or not, which may affect the way the firm matures (or develops) its organisational and project capabilities. It also raises the issue of 'intelligent client' behaviour (Maylor & Johnson, 2009), enhancing the capabilities of client organisations to be better participants in co-creating value (Ordanini & Pasini, 2008; Prahalad & Ramaswamy, 2004; Vargo, Maglio, & Akaka, 2008) through projects. This paper suggests that future research can be done in these areas to enhance our understanding of the development (maturity) of capabilities in project environments.

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